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Farmers' Perception of and Adaptation to Climate Change and Variability: The Case of Assosa District, Western Ethiopia

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Abstract
This study identified farmers' perception of and adaptation to climate change and variability in Assosa district, western Ethiopia, which is severely affected by climate change stresses. Both primary and secondary data were used for the study. Primary data were collected from a randomly selected 140 sample households using interview schedule. Relevant secondary data were also obtained from NMA (National Metrology Agency), Assosa district office of agriculture and different reports. Descriptive statistics such as frequency, percentage and graph were used to describe the farmers' perception of and adaptation to climate change and variability. In addition, trend analysis (simple linear regression) was used to analyze secondary obtained on temperature and rainfall from NMA. The descriptive statistics result pointed out that the majority (96.3%) of the farmers in the study area perceived a change in temperature and it also indicated that 90.7% of the farmers' perceived a change in the amount and timing of annual rainfall pattern over the past 15 years. In addition, the trend analysis indicated that the average annual temperature in the study area increases by about 0.096^{o}C each year. It also found that the annual rainfall in the study area decreases by about 46.75 mm each year. Furthermore, the study also pointed out that, 57.1%, 55%, 50.7%, 49.3% and 36.4% of the household heads used crop diversification, irrigation, improved crop varieties, adjusting planting date and soil conservation techniques, respectively, as climate change and variability adaptation measure in the study area. Thus, actions directed towards reducing the impact of climate change and variability should focus on creating awareness on the impact of climate change and variability, ensuring availability and dissemination of improved crop varieties, improving the availability of irrigation facilities, *etc.*
Keywords: Climate change and variability, Perception, Adaptation, Assosa district, Western Ethiopia

1. INTRODUCTION

Climate change and variability are a global issue as it affects the livelihood of the world community. Its adverse impacts are considered to be particularly strong in countries located in tropical Africa that depend on agriculture as their main source of livelihood. Its effect on agriculture arises due to the fact that agriculture uses climate variables (like temperature, rainfall, humidity, solar energy, etc) as important inputs (Edwards-Jones *et al*., 2009). Climate change and variability in the form of higher temperature, reduced rainfall and increased rainfall variability reduces crop yield and threatens food security in low-income and agriculture-based economies (Aemro *et al*., 2012).

As to Ringer (2008) in Ethiopia climate change and variability has already led to a decline in agricultural production, and cereal production is expected to decline still further under moderate global warming. Moreover, it has led to a shortage of food, a decline in biodiversity, and increases in human and livestock health problems, rural-urban migration and dependency on external support. Due to weak institutional capacity, limited engagement in environmental and adaptation issues and a lack of validation of local knowledge the study area is highly affected by climate change and variability (Temesgen *et al.*, 2008). In addition, various reports agree that the region has been facing droughts that have occurred in the country indicating susceptibility of the region to climate change.

According to Adger *et al.* (2007) adaptation to climate change and variability is a process of adjusting the natural or human systems in response to actual or expected climatic stimuli or their effects to reduce harm or exploit beneficial opportunities. Therefore, the fact that climate has changed in the past and continues to change in the future implies the need to understand how farmers perceive climate change and variability and adapt in order to guide strategies for adaptation in the future. In addition, a better understanding of the local dimensions of farmers' perception along with meteorological data and adaptation is therefore essential to develop appropriate policy measures that will mitigate these adverse consequences. Thus, these are the gaps of knowledge that this study intends to bridge. This study aimed at investigating farmers' perception of and adaptation to climate change and variability in response to adverse effects of climate change and variability.

2. METHODOLOGY

2.1. Description of the Study Area

Assosa district, the study area, is one of the 20 districts of the Benishangul Gumuz region. Agro-ecologically, the district is mostly classified as lowland (kola) with an average rainfall of 1275 mm per annum and an altitude

range of 1300-1570 meter above sea level. The total population of the district was 92,687, of whom about 73.98% live in rural set-ups while the remaining 26.01% were urban dwellers. Moreover, mixed farming (crop production and livestock rearing) is the predominant sources of livelihood for the majority of the population in the area. The crop production is dominated by rain fed agriculture and livestock rearing is practiced in a traditional way (BGRDGA, 2010).

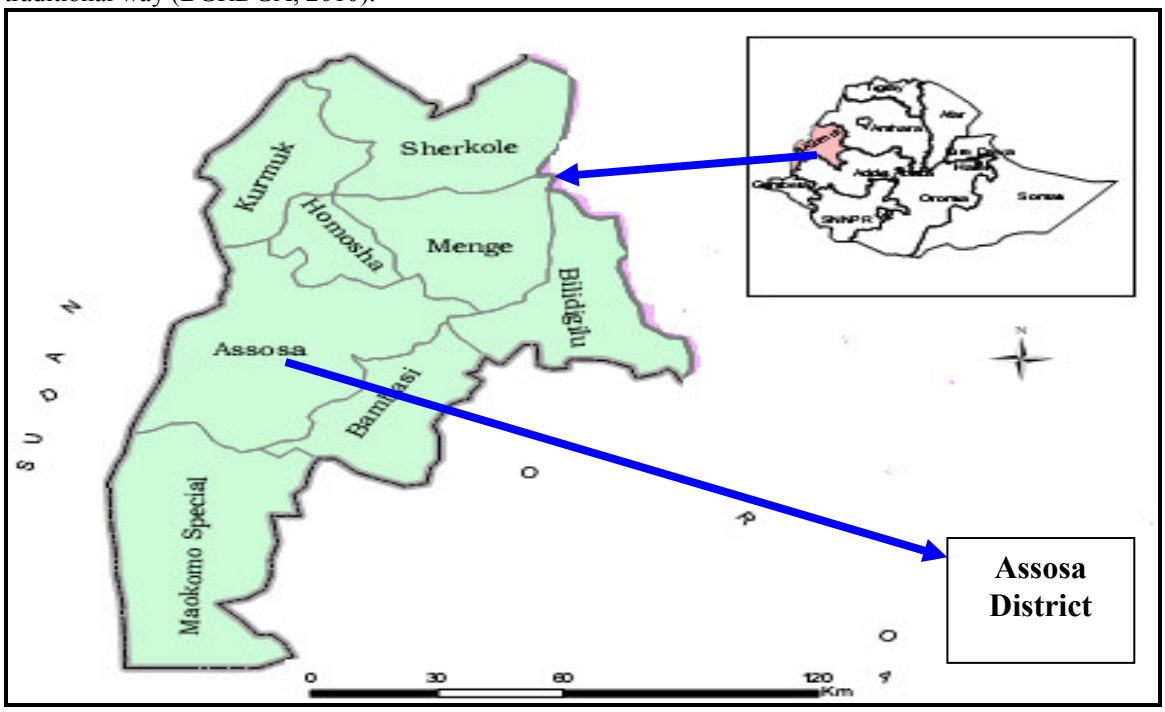

Figure 1. Location map of the study area

2.2. Sampling Design

A two-stage random sampling technique was applied to select sample households. In the first stage, ten peasant associations were randomly selected out of the total 74 Peasant associations in the district. In the second stage, a total of 140 household heads was selected randomly using probability proportional to size of households in the selected peasant associations.

2.3. Data Sources and Methods of Data Collection

For this study, both primary and secondary data were used. Primary data were obtained from sample households in the district using interview schedule. Relevant secondary data were also collected from the national meteorology agency, Assosa district office agriculture and different reports.

2.4. Methods of Data Analysis

As to the methods of data analysis, descriptive statistics such as percentages, frequency and graph as well as trend analysis (simple linear regression) were used to describe the farmers' perception of and adaptation to climate change and variability and to analyze the trend of major climate variables in the study area.

3. RESULTS AND DISCUSSION

3.1. Farmers' Perception of Climate Change and variability

In order to get essential information and insight into farmers' adaptation to climate change and variability, looking at farmers' perception on each parameter/indicators are quite important. For this purpose, two known climate attributes: temperature and precipitation have been used. Parameters such as annual average temperature, mean annual maximum temperature, mean annual minimum temperature and annual rainfall were used to support/substantiate farmers' perception of climate change and variability.

To describe farmers' perceptions of climate change and variability, it is important first to look at how climate data recorded at meteorological stations evolved (trends) and how farmers perceived these changes. Tests were undertaken for linear trend in average annual temperature, average annual maximum temperature, average annual minimum temperature and annual rainfall using data obtained from Assosa station meteorology agency against time.

3.1.1. Farmers perception on temperature changes

Most of the farmers perceived occurrence of long-term changes in temperature. About 92 percent perceived that the temperature in the area is increasing. Four percent of the farmers noticed a decrease in temperature, 2.2% have not noticed any changes in the temperature and 1.4% of the farmers don't know whether there is a change in the temperature or not (Table 1). The statistical record of temperature data from the area between 2000 and 2013 (Appendix Table 1) also shows an increasing trend. The trend analysis between the average annual temperature and time indicated that average temperature in the study area increases by about 0.096 ^{o}C each year (Figure 2). The trend analysis between the mean maximum annual temperature and time also indicated that maximum annual temperature in the study area increases by about 0.12 ^{o}C each year (Figure 3). Moreover, the trend analysis between mean minimum annual temperature and time also shows an increase in one year time results in an increase in the minimum temperature of the area by 0.059 ^{o}C (Figure 4). Thus, farmers' perceptions appear to be in accordance with the statistical record of the area. This finding is in line with the finding of Almaz (2009).

Table 1: Perceptions of sample households on average annual temperature change during the last 15 years

Perceived change	Number of respondents	Percentage
Increased	129	92.1
Decreased	6	4.3
No change	3	2.2
I don't know	2	1.4

Source: Own survey result, 2014

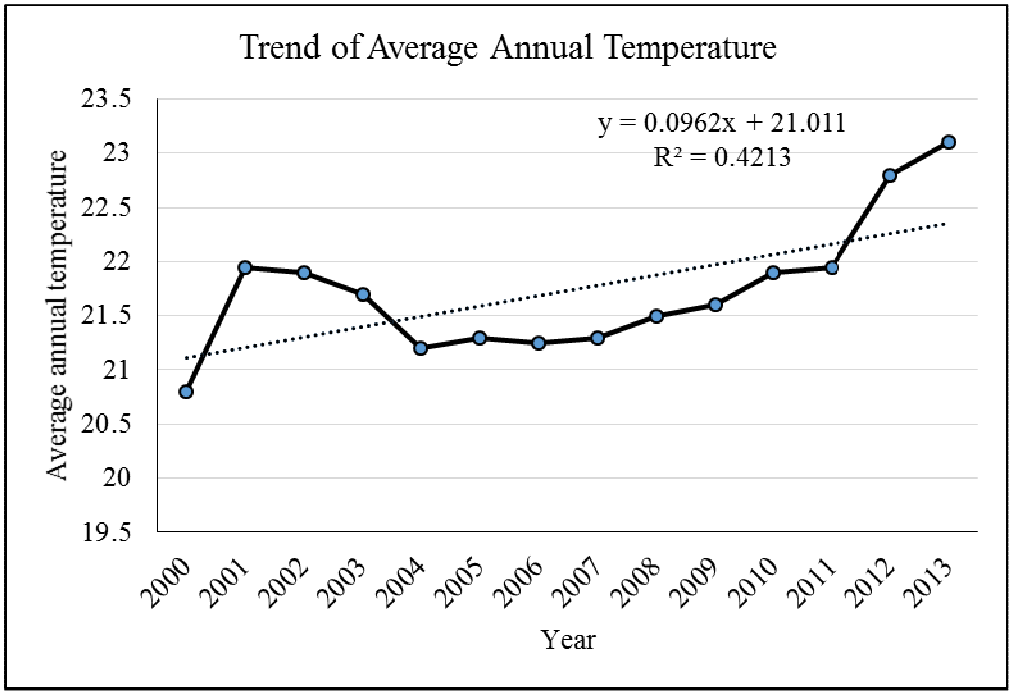

Figure 2: Trend of average annual temperature in Assosa area from 2000-2013

Source: Computed based on data obtained from the National Meteorological Agency, Assosa branch

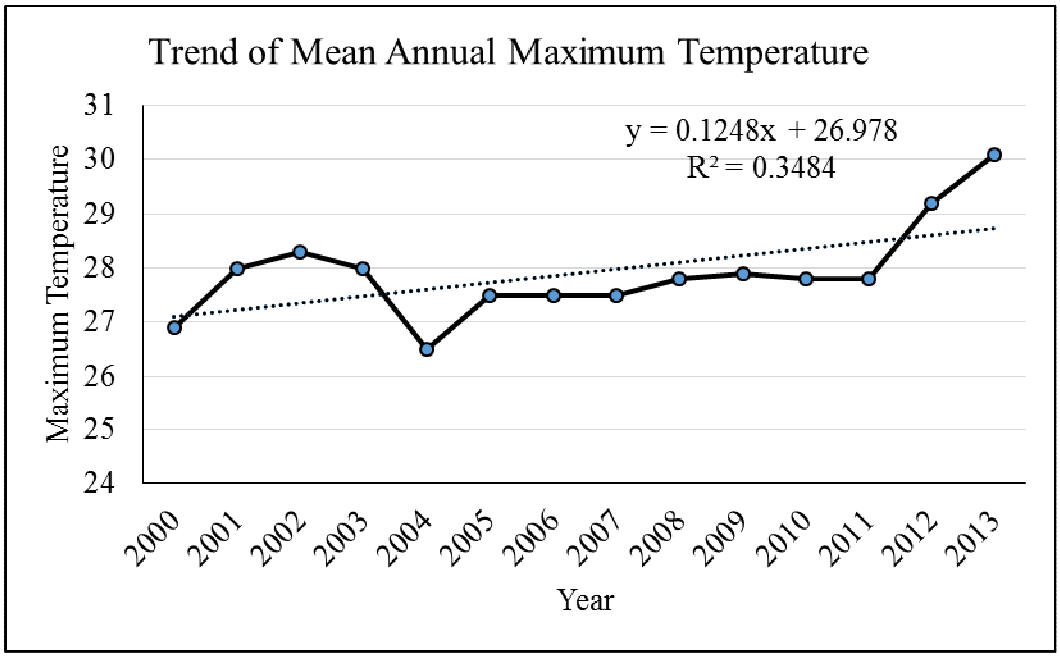

Figure 3: Trend of mean annual maximum temperature in Assosa area from 2000-2013
Source: Computed based on data obtained from the National Meteorological Agency, Assosa branch

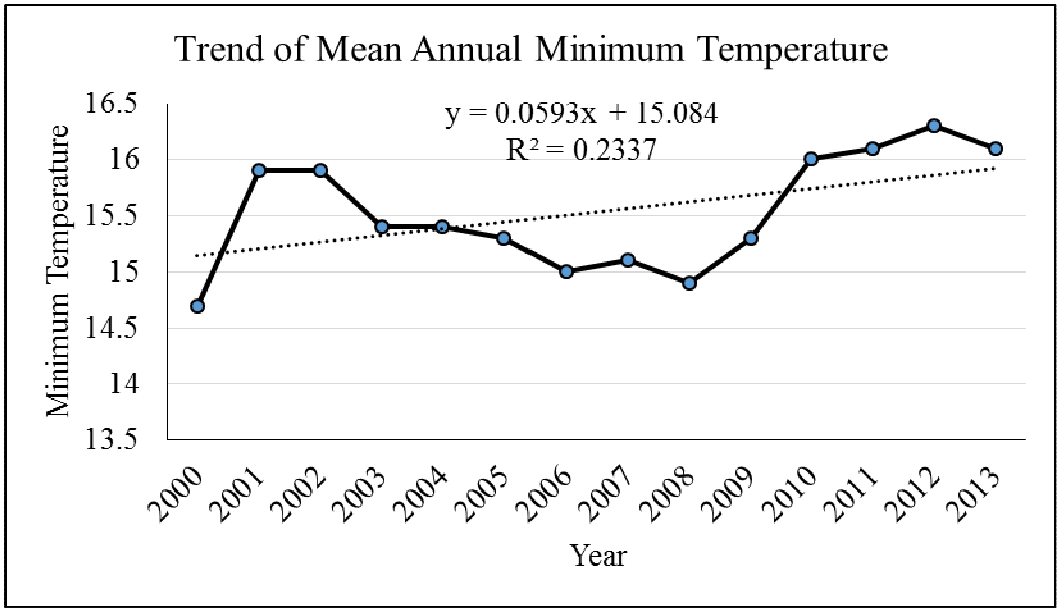

Figure 4: Trend of mean annual minimum temperature in Assosa area from 2000-2013
Source: Computed based on data obtained from the National Meteorological Agency, Assosa branch

3.1.2. Farmers perception of precipitation (rainfall) changes

About 91% of the respondents observed changes in rainfall patterns over the past 14 years, and 82.1% observed a decrease in the amount of rainfall (Table 2). About 8.6% of the respondents noticed an increase in the total amount of rainfall and 9.3% the respondents noticed no change in the amount of rainfall.

Table 2: Perception of sample respondents on rainfall patterns during the last 14 years

Perceived change	Number of respondents	Percentage
Increased	12	8.6
Decreased	115	82.1
No change	13	9.3

Source: Own survey result, 2014

The trend analysis between annual rainfall and time using data obtained from the meteorology agency indicated that annual rainfall in the study area decreases by about 46.75 mm each year (Figure 5). This is in line with the finding of Getenet (2013).

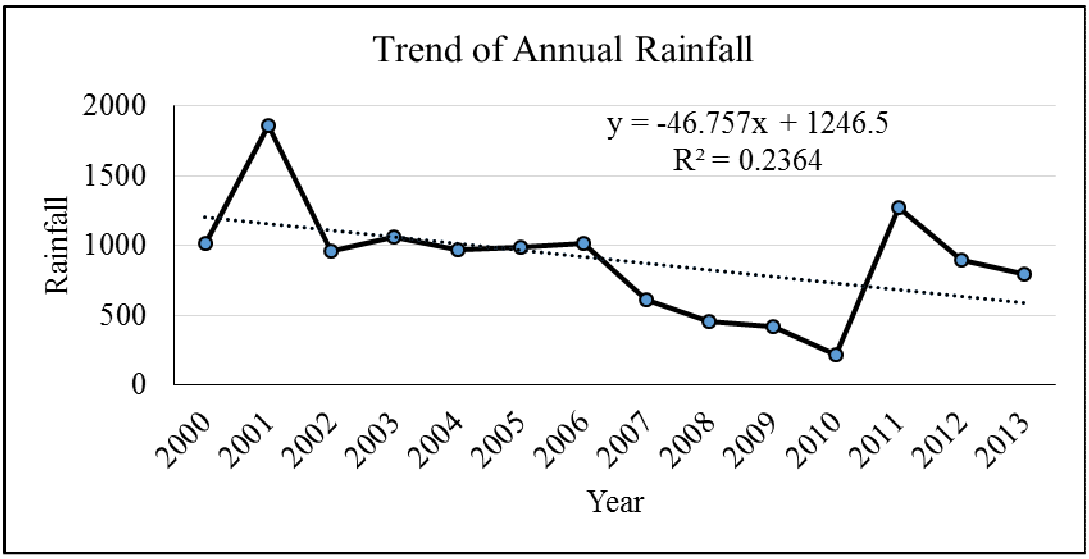

Figure 5: Trend of annual rainfall in Assosa area from 2000-2013
Source: Computed based on data obtained from the National Meteorological Agency, Assosa branch

3.2. Farmers Adaptation to Climate Change and Variability

In the study district, farmers have adopted different strategies to reduce the consequences of climate change so far and to manage future patterns in climate change and variability. In order to reduce its consequences farmers used a combination of adaptation options. Accordingly, 57.1%, 55%, 50.7%, 49.3% and 36.4% of the household heads were using crop diversification (mixed cropping, intercropping and dividing farm lands into varying crops), irrigation, improved crop varieties (drought resistant and short maturing varieties), adjusting planting date and soil conservation techniques (Soil/stone bunds, tied ridging, ridging, *etc*.), respectively, as climate change and variability adaptation measure in the study area (table 3). This implies that the farmers in the study area used one or more than one adaptation measure in order to reduce its negative consequences of climate change and variability as well as to exploit different opportunities arising from climate change and variability to improve their livelihood (Seid *et al*., 2016).

Table 3: Summary of adaptation strategies used by farmers

Adaptation strategies	Number of respondents	Percent (%)
Using irrigation	77	55
Using improved crop Improved varieties	71	50.7
Adjusting (changing) planting date	69	49.3
Diversification of crops	80	57.1
Using soil conservation practices	51	36.4

Source: Survey result
Note that a farmer can have more than one adaptation strategy.

4. CONCLUSIONS AND RECOMMENDATIONS

As climate change and variability affect the livelihood of the rural poor, understanding how farmers perceive about climate change and variability as well as the adaptation options they use facilitates the formation of policies and investment strategies that help moderate potential adverse consequences of long-term climate change and variability. Therefore, the study examined farmers' perception of and adaptation to climate change and variability using a data collected from a total of 140 sample household heads. The finding of the study revealed that about 96.3% of the sampled households' perceived a change in temperature over the past 15 years. It also pointed out that about 90.7% of the farmers perceived a change in the amount and timing of annual rainfall over the past 15 years. This implies that almost all the farmers in the study area perceived the presence of climate change and variability.

Moreover, the trend analysis showed a significant change in the two important climate elements (temperature and rainfall) that affects agricultural activity in rural areas over the past 14 years. Accordingly, the study found that the average annual temperature, mean annual maximum temperature and mean annual minimum temperature increases by about 0.096, 0.1248 and 0.059^{o}C each year, respectively. In addition, it also indicated that annual rainfall in the study area decreases by about 46.75 mm each year. Therefore, this finding supports the perception of farmers about climate change and variability in the study area.

So as to reduce the impact of climate change and variability farmers used changing/adjusting planting date, soil conservation techniques, improved crop varieties (like short duration varieties and drought resistance varieties), crop diversification (mixed cropping, intercropping and dividing farm lands into varying crops), and irrigation as an adaptation measures. Accordingly, 57.1%, 55%, 50.7%, 49.3% and 36.4% of the household heads were using crop diversification, irrigation, improved crop varieties, adjusting planting date and soil conservation techniques, respectively, as climate change and variability adaptation measure in the study area.

Thus, future policy as well as actions directed towards improving farmers livelihood should focus on:

- ✓ awareness creation on the impact of climate change and variability and the roles of the adaptation measures through different sources such as media, training and extension;
- ✓ facilitating the availability of credit, especially to adaptation technologies;
- ✓ ensuring the availability of different types of improved crop varieties;
- ✓ enhancing research on use of new crop varieties that are more suited to drier conditions;
- ✓ improving the availability of irrigation materials; etc.

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Appendix Table 1: Long-term climate data of Assosa area from 2000-2013

Year	Maximum temperature(^{0}C)	Minimum temperature(^{0}C)	Average annual temperature(^{0}C)	Annual rainfall (mm)
2000	26.9	14.7	20.8	1016.8
2001	28.0	15.9	21.95	1858.3
2002	28.3	15.9	21.9	960.5
2003	28.0	15.4	21.7	1059.1
2004	26.5	15.4	21.2	969.9
2005	27.5	15.3	21.3	991.5
2006	27.5	15.0	21.25	1012.1
2007	27.5	15.1	21.3	610.8
2008	27.8	14.9	21.5	458.3
2009	27.9	15.3	21.6	420.8
2010	27.8	16.0	21.9	219.7
2011	27.8	16.1	21.95	1268.1
2012	29.2	16.3	22.8	898.6
2013	30.1	16.1	23.1	796.5

Assosa Meteorology Station, 2014